M ath D iagnostic T est

20 Q uestions
35 M inutes

For questions in the Q uantitative C om parison form at ("Q uantity A " and "Q uantity B " given),the answ er choices are alw ays as follow s:

(A) Q uantity A is greater.
(B) Q uantity B is greater.
(C) The tw o quantities are equal.
(D) The relationship cannot be determ ined from the inform ation given.

For questions follow ed by a num eric entry box ☐,you are to enter your ow n answ er in the box.For questions follow ed by fraction-style num eric entry boxes ☐/☐,you are to enter your answ er in the form of a fraction.Y ou are not required to reduce fractions.For exam ple,if the answ er is 1/4,you m ay enter 25/100 or any equivalent fraction.

A ll num bers used are real num bers.A ll figures are assum ed to lie in a plane unless otherw ise indicated.G eom etric figures are not necessarily draw n to scale.Y ou should assum e,how ever,that lines that appear to be straight are actually straight,points on a line are in the order show n,and all geom etric objects are in the relative positions show n.C oordinate system s,such as *xy*-planes and num ber lines,as w ell as graphical data presentations such as bar charts,circle graphs,and line graphs, *are* draw n to scale.A sym bol that appears m ore than once in a question has the sam e m eaning throughout the question.

1.

Q uantity A	**Q uantity B**
$0.0\overline{1410}$	$0.\overline{0141}$

2.A certain bookstore sells only paperbacks and hardbacks.Each of the 200 paperbacks in stock sells for a price betw een $8 and $12,and each of the 100 hardbacks in stock sells for a price betw een $14 and $18.

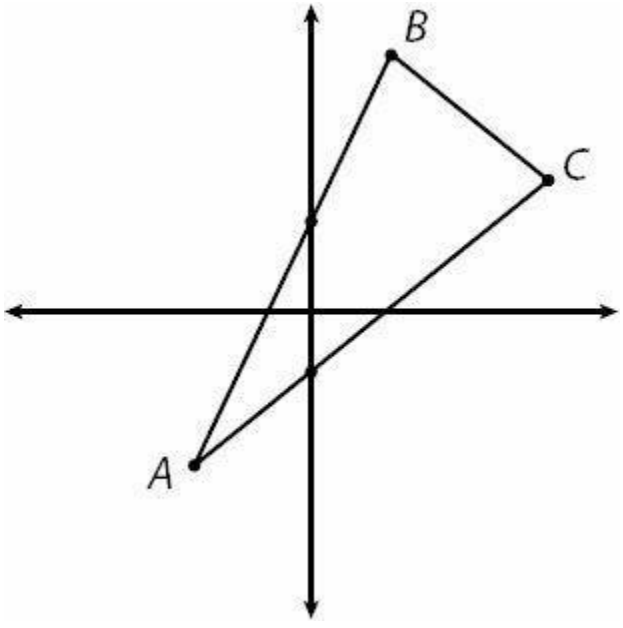
Q uantity A	**Q uantity B**
The average price of the books in stock at the bookstore	$9.99

3.

$2 < x < 4$

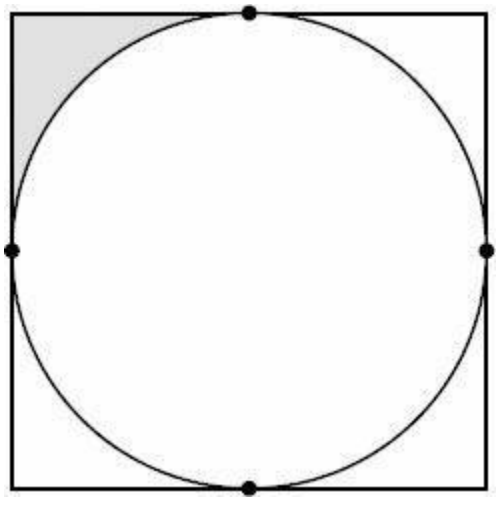
Q uantity A	Q uantity B
$\frac{x-3}{-x}$	$\frac{3-x}{-x}$

4.



Q uantity A	Q uantity B
The slope of line segm ent *AB*	The slope of line segm ent *AC*

5.



In the figure above,the circle is inscribed a square that has area 16.

Q uantity A	Q uantity B
The area of the shaded region	1

6.

$a > 1$

$b > 5$

Q uantity A	Q uantity B
a $(5b)$	$2a$ (b)

7.

Q uantity A	Q uantity B
$(5 + a)(3 + a)$	$a^2 + 2a + 15$

8.

In Triangle ABC ,$AB = 12$,$AC = 10$,and $BC = 5$.

Q uantity A	Q uantity B
The m easure of angle A	The m easure of angle C

9.If $\frac{52}{x}$ is a positive integer,how m any integer values are possible for x?

(A) 5
(B) 6
(C) 7
(D) 8
(E) 10

10.If $3x + 6y = 69$ and $2x - y = 11$,w hat is the value of y?

11.If $7^9 + 7^9 + 7^9 + 7^9 + 7^9 + 7^9 + 7^9 = 7^x$,then x=

(A) 9
(B) 10
(C) 12
(D) 63
(E) 9^7

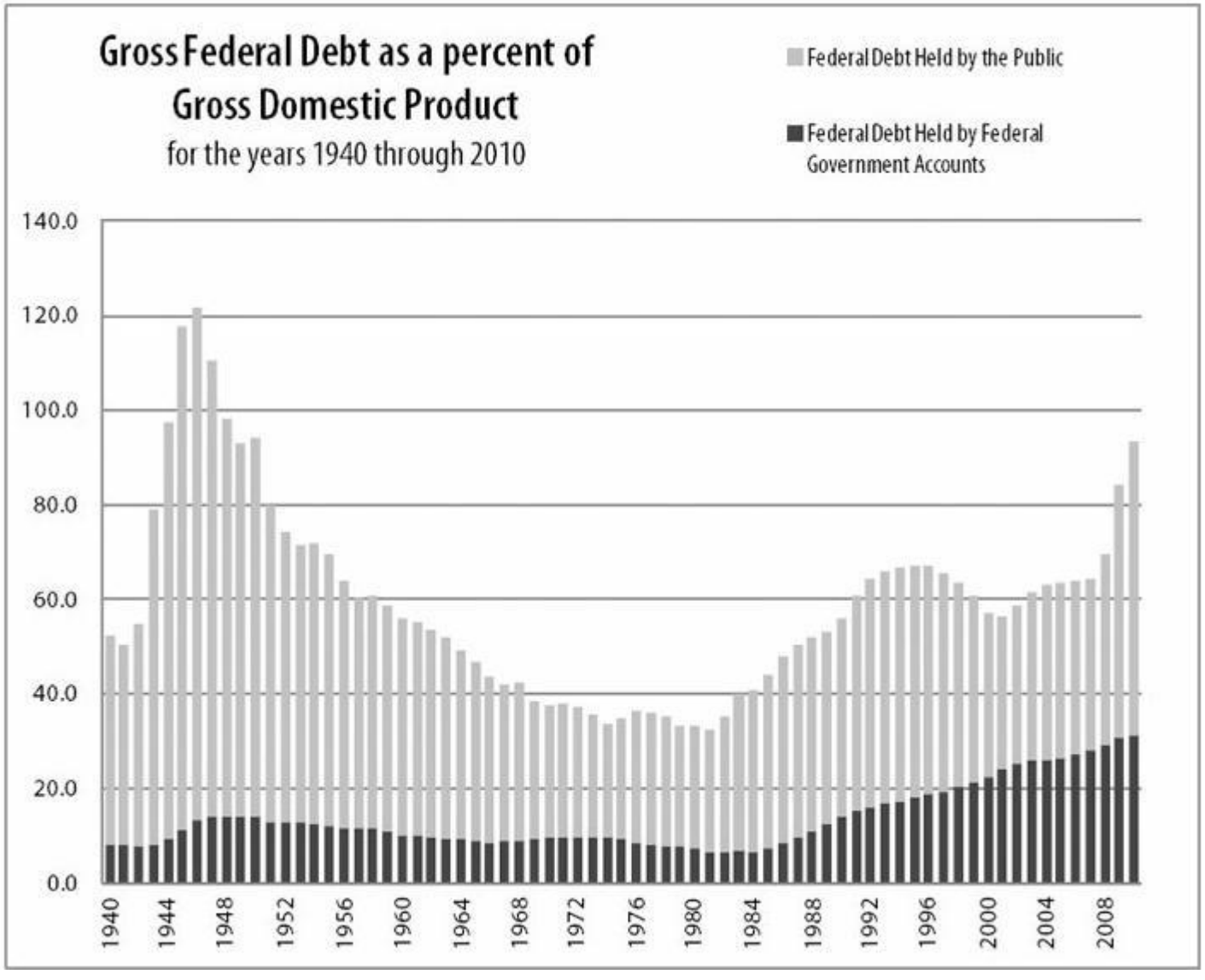
12.In a certain election race,all of the 8,400 votes w ere cast for either C andidate A or C andidate B .If votes for C andidate A and votes for C andidate B w ere cast in a 4 to 3 ratio,how m any votes w ere cast for C andidate A ?

13.W hat is the sum of all the integers from -457 to 459,inclusive?

14. $a^3b^4c^7 > 0$. Which of the following statements must be true? Indicate all such statements.

- ☐ ab is negative
- ☐ abc is positive
- ☐ ac is positive

Questions 15–17 are based on the following chart.



15. In how many years between 1940 and 2010, inclusive, did the gross federal debt exceed the gross domestic product?

(A) 3
(B) 4
(C) 5
(D) 6

(E) m ore than 6

16.D uring w hich decade w as federal debt held by federal governm ent accounts closest to half of all federal debt?

(A) 1960’s
(B) 1970’s
(C) 1980’s
(D) 1990’s
(E) 2000’s

17.A t its highest point,w hat w as the approxim ate ratio of federal debt held by the public to that held by federal governm ent accounts?

(A) 1 : 1
(B) 2 : 1
(C) 5 : 1
(D) 8 : 1
(E) 12 : 1

18.A num ber x is 32% of a num ber y.If y is 20% of z,then,expressed in term s of x,z =

(A) $0.064x$
(B) $0.64x$
(C) $6.4x$
(D) $\frac{x}{0.064}$
(E) $\frac{x}{0.64}$

19.If $S^2 > T^2$,w hich of the follow ing m ust be true?

(A) $S > T$
(B) $S^2 > T$
(C) $ST > 0$
(D) $|S| > |T|$
(E) $ST < 0$

20.In a certain nation,every citizen is assigned an identification num ber consisting of the last tw o digits of the person’s birth year,follow ed by five other num erical digits.For instance,a person born in 1963 could have the identification num ber 6344409.H ow m any identification num bers are possible for people born in the years 1980– 1982,inclusive?

(A) 360
(B) 2,880
(C) 288,800
(D) 300,000
(E) 2,400,000

Quantitative Diagnostic Test: Answer Tally Sheet

Question #	Your Answer	Correct Answer	Tally your correctly answered questions. *No partial credit!*	Find more questions like this in chapter:
1		(C)		11
2		(A)		17
3		(D)		15
4		(A)		28
5		(B)		29
6		(B)		14
7		(D)		8
8		(B)		27
9		(B)		13
10		7		8
11		(B)		14
12		4,800		20
13		917		15
14		III only		15
15		(A)		24
16		(E)		24
17		(D)		24
18		(D)		12,19
19		(D)		9,15
20		(D)		23
	Raw Verbal Score: (# of quant questions answered correctly)			

Quantitative Diagnostic Test: Scoring Guide

Raw Quantitative Score	Quantitative Reasoning Diagnostic Scaled Score

20	169 – 170
19	167 – 169
18	164 – 166
17	161 – 163
16	159 – 161
15	157 – 159
14	155 – 157
13	153 – 155
12	152 – 154
11	150 – 152
10	149 – 151
9	147 – 149
8	145 – 147
7	143 – 145
6	142 – 144
5	139 – 141
4	136 – 138
3	133 – 135
2	130 – 132
1	130 – 131
0	130

N O TES:

D iagnostic Scaled Score is approxim ate.

(a) If your tim e for this diagnostic section exceeded the 35-m inute guideline,this approxim ate score m ay not be indicative of your perform ance under standard tim e conditions.

(b) Scaled Score depends not only on how m any ques-tions w ere answ ered correctly (R aw Score),but also on the overall difficulty of the set of questions.This diagnostic test approxim ates the difficulty of the official G R E ® revised G eneral Test.

M ath D iagnostic T est A nsw ers

1.**(C).**In a repeating decim al,the portion under the bar repeats w ithout end.In Q uantity A ,the portion “1410” repeats, after an initial 0.0 that does not repeat.In Q uantity B ,the portion “0141” repeats,starting im m ediately after the decim al.To com pare,w rite out m ore digits of each decim al:

Q uantity A :0.0141014101410…
Q uantity B :0.0141014101410…

The tw o num bers are identical;Q uantity A and Q uantity B are sim ply different w ays of w riting the sam e num ber.

2.**(A).**B ecause there are tw ice as m any paperbacks as hardbacks in stock,the overall average price w ill be closer to the price of the paperbacks than the price of the hardbacks.H ow ever,the fact that the problem gives price *ranges* instead of prices com plicates m atters a bit.C alculate the low est possible overall average and the highest possible overall average to see w hether that average can be both low er and higher than $9.99.

To calculate the low est possible overall average,assum e the low est price for all paperbacks and all hardbacks ($8 and $14,respectively).N ote that there are tw ice as m any paperbacks as hardbacks,w hich essentially double-w eights the $8:

$$\frac{200(\$8)+100(\$14)}{200+100}=\frac{2(\$8)+1(\$14)}{3}=\frac{\$30}{3}=\$10$$

This m inim um price is already greater than $9.99,so the m axim um price w ould also be greater,and there is no need to calculate it.

Q uantity A is greater.

3.**(D).**Since $2 < x < 4$,test values betw een 2 and 4 in both Q uantities to see w hich Q uantity is larger for each exam ple.Y ou m ust A LW A Y S test m ore than one value to determ ine the answ er to a Q uantitative C om parison,as you should try to prove (D),or at least test w hether you can.

If $x = 2.5$,Q uantity $A=\frac{2.5-3}{\quad}=\frac{-0.5}{\quad}=\frac{5}{\quad}=\frac{1}{\quad}$ and Q uantity $B=\frac{3-2.5}{\quad}=\frac{0.5}{\quad}=\frac{-5}{\quad}=\frac{-1}{\quad}$.In this case,Q uantity A is larger.

B efore just random ly trying other values betw een 2 and 4,try to strategize: could you find an exam ple in w hich Q uantity B is greater? Since the tw o Q uantities have the sam e denom inator,focus on the num erators.x - 3 is positive w hen $x > 3$ and negative w hen $x < 3$.Since the first num ber tested w as less than 3,next try som ething greater than 3.

If $x = 3.5$,Q uantity $A=\frac{3.5-3}{-3.5}=\frac{0.5}{-3.5}=\frac{-5}{35}=\frac{-1}{7}$ and Q uantity

$B = \frac{3-x}{-x} = \frac{3-3.5}{-3.5} = \frac{-0.5}{-3.5} = \frac{5}{35} = \frac{1}{7}$.In this case,Q uantity B is larger.(N ote: you could have stopped calculating the exact values of Q uantity A and Q uantity B for this exam ple once it becam e clear that Q uantity A w as negative and Q uantity B w as positive.)

A lternatively,it w ould also be strategic to think about w hat num ber,if any,could m ake the tw o quantities equal.If x = 3,Q uantity A = Q uantity B = 0 because both num erators w ill be 0 and 0 divided by any non-zero num ber is just 0.

Since Q uantity A is greater than Q uantity B for som e exam ples of x w here $2 < x < 4$,but Q uantity B is greater than Q uantity A for other exam ples w here $2 < x < 4$,the correct answ er is (D).

4.**(A).**W hile there are no num bers on the graph,both lines have clearly positive slopes (the lines rise upw ard w hen reading from left to right) and segm ent *AB* is clearly steeper than segm ent *AC* .Thus,segm ent *AB* has a greater slope.

W hile you should be cautious about m aking assum ptions on the G R E,the fact that the tw o lines form tw o sides of a triangle and m eet at vertex *A* show s that the lines are not parallel,and segm ent *AB* ,w hich rises above segm ent *AC* to the right of their m eeting point,is definitely steeper.

5.**(B).**If the area of the square is 16,then the side of the square is 4.Since the circle is inscribed in the square,its diam eter is 4 and its radius is 2.Since the area of a circle is πr^2,the area of this circle is 4π.Thus,the com bined area of the four “corners,” outside the circle but inside the square,is 16 - 4π.The shaded region is one of these four identical “corners,” so the area of the shaded region is $\frac{16-4\pi}{4} = 4 - \pi \approx 4 - 3.14 = 0.86$,w hich is less than 1.

Q uantity B is greater.

6.**(B).**Since both quantities have the sam e exponent as w ell as at least one *b* inside the parentheses,one w ay to com pare the quantities is to distribute that exponent.

Q uantity A : $(5b)^a = 5^a b^a$

Q uantity B : $(b^2)^a = (b \times b)^a = b^a b^a$

B ecause b^a is positive (i.e.,a positive base to a positive pow er) and com m on to both quantities,it can be ignored or canceled from both.

Q uantity A : 5^a

Q uantity B : b^a

B ecause the positive exponent is com m on to both quantities,a larger base indicates the greater quantity.B ecause $b > 5$,Q uantity B is greater.

7.**(D).**FO IL the term s in Q uantity A :

$(5 + a)(3 + a) = 15 + 5a + 3a + a^2 = a^2 + 8a + 15.$

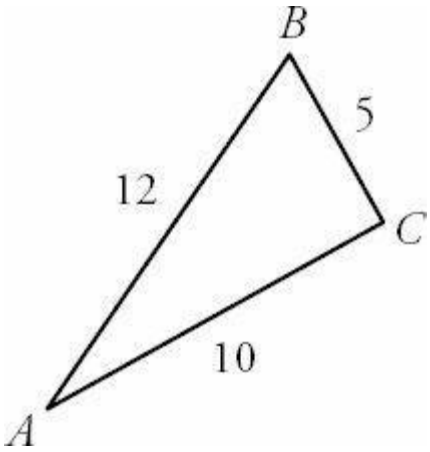
Since a^2 and 15 appear in both quantities,elim inate them .

Q uantity A = 8*a*
Q uantity B = 2*a*

If *a* is positive,Q uantity A is greater.If *a* is negative,Q uantity B is greater.If *a* is zero,the tw o quantities are equal. W ithout inform ation about *a*,it cannot be determ ined w hich quantity is greater.

(N ote also,because neither quantity is set equal to zero or any other num ber,you cannot actually "solve" either quantity to get roots or solutions for *a*.)

8.**(B).**B egin by draw ing the triangle described by the text and labeling the sides:



A ccording to the properties of triangles,the longer the side opposite an angle,the larger the angle itself m ust be. Since angle *A* opens to the shortest side length 5 but angle *C* opens to the longest side length 12,it m ust be true that angle *C* > angle *A* .Thus,Q uantity B is greater.

$\frac{52}{x}$

9.**(B).**If x is a positive integer,then *x* is a factor of 52 (i.e.,*x* divides evenly into 52).This question can m ost easily be solved by listing factor pairs for 52,as listing in pairs w ill help prevent om issions.Each pair m ultiplies to 52.

The factors of 52 are:

1 & 52
2 & 26
4 & 13

H ow can you be sure this list is com plete? Looking dow n the left colum n,1 and 2 m ade the list,then 3 didn't divide evenly into 52,then 4 did.Since 4 pairs w ith 13,check the other integers betw een 4 and 13.Since 5,6,7,8,9,10,11, and 12 don't divide evenly into 52,this list is com plete.There are 6 factors,so the answ er is (B).

10.**7.**M ultiply each term of the second equation by 6: 12*x* - 6*y* = 66.W hy do this? B ecause the first equation has a

6*y*,and the *y* term s w ill now cancel w hen the equations are added.

N ew second equation:	$12x - 6y = 66$
+ First equation:	$3x + 6y = 69$
Sum :	$15x = 135$
	$x = 9$

Plug $x = 9$ back into an original equation to get *y*.

$2x - y = 11$
$2(9) - y = 11$
$18 - 11 =$
$y\ y = 7$

In sum m ary,$x = 9$ and $y = 7$.B e sure to answ er for *y*,not *x*.

11.**(B).**Factor 7^9 out of $7^9 + 7^9 + 7^9 + 7^9 + 7^9 + 7^9 + 7^9$ to get:

$$7^9 (1 + 1 + 1 + 1 + 1 + 1 + 1) = 7^9 (7)$$

O r,just count that there are seven 7^9's in the original sum ,w hich can be w ritten as 7×7^9.

Since 7^9 (7) is the sam e as 7^9 (7^1),sim plify further: $7^9 (7^1) = 7^{(9 + 1)} = 7^{10}$.Thus,$x = 10$.

N ote: it is N O T correct to sim ply add the original exponents together.W hen adding or subtracting exponential expressions w ith the sam e base,it is not possible to directly com bine exponents.Factoring out is the correct procedure.

12.**4,800.**If votes for C andidate A and votes for C andidate B w ere in a 4 to 3 ratio,then for every 4 votes C andidate A got,C andidate B got 3.Y ou can think of these votes as existing in "sets" of 7 votes.

D ivide 8,400 by 7 to get 1,200.Thus,the votes w ere cast in 1,200 "sets" of 7.In each "set," the votes w ent A A A A B B B (4 votes for A ,3 for B).Thus,the total num ber of votes for A is $1,200 \times 4 = 4,800$.

13.**917.**There m ust be a trick to this,as it w ould be im possible to sum so m any num bers under G R E tim e constraints, even w ith a calculator.To see the trick,try an exam ple w ith m uch sm aller num bers.For instance,w hat is the sum of al the integers from -2 to 4,inclusive?

NEW EXAMPLE: $\cancel{-2} + \cancel{-1} + \cancel{0} + \cancel{1} + \cancel{2} + 3 + 4 = 7$

That is,-2 and 2 cancel,-1 and 1 cancel,and 0 has no im pact on the sum .So the sum is sim ply the leftover num bers at the end,3 + 4 = 7.

Sim ilarly,in the set -457,-456 … 0 … 456,457,458,459,all the integers from -457 to 457 cancel each other out. O nly 458 and 459 rem ain.The sum is 458 + 459 = 917.

14.**III only.**Since b^4 m ust be positive,if $a^3b^4c^7$ is positive,a^3c^7 m ust also be positive.Since putting an *odd* exponent on a num ber doesn't change w hether the num ber is positive or negative,*ac* m ust be positive,so Statem ent III is true. The other statem ents require know ledge of the sign of *b,*w hich is not know n here,since the even exponent "hides" w hether the underlying base is positive or negative.

15.**(A).**The chart expresses gross federal debt as a percent of gross dom estic product,so federal debt exceeded gross dom estic product in any year in w hich the value of the graph rose above 100.O nly during 3 years in the 1940s does the graph extend above 100.

16.**(E).**Federal debt held by federal governm ent accounts w ould be half of all federal debt in any year in w hich the dark,bottom portion of the bar equaled the lighter,top portion.A lthough it never actually reached 50% of the total federal debt,the dark portion of the bar cam e closest to equaling the light portion during the 2000s.

17.**(D).**The ratio of federal debt held by the public to that held by federal governm ent accounts for any given year w ould be the m easure of the lighter,top bar over the m easure of the darker,bottom bar for that year.(To get the m easure of the lighter,top bar,you m ust subtract the value of the darker,bottom bar.)

W hile the federal governm ent accounts percentage hovered near the low teens throughout m ost of the graph,debt held by the public rose above 100% during portions of the 1940s.Identify the year in w hich the lighter,top bar is the largest in com parison to the darker,low er portion.In this chart,it happens to be the tallest bar overall,w hich w as 1946,although it's not necessary to identify the exact year.

Total bar: 120 (actually a bit m ore)
D ark,bottom bar: 15 (or a bit less)
Light,top bar: 120 (or m ore) - 15 (or less) = 105 (or a bit m ore)

The ratio is thus 105 (slightly m ore): 15 (m aybe less),w hich is 7 : 1 (or a bit higher).A m ong the given options,this ratio is closest to 8 : 1.

18.**(D).**Translate the percent relations in the problem into algebraic statem ents.First,"a num ber x is 32% of a num ber y" becom es

$$x = 0.32y$$

Sim ilarly,"y is 20% of z" becom es

$$y = 0.2z$$

Substituting for y from the second equation into the first elim inates y and gives the follow ing relationship betw een x and z:

$$x = 0.32(0.2z)$$
$$x = 0.064z$$

Finally,the problem asks for z in term s of x,so isolate the variable z by dividing both sides of the equation by 0.064.

$$z = \frac{x}{0.064}$$

19.**(D).**The square root of a squared variable is equal to the absolute value of that variable: $\sqrt{x^2} = |x|$,not *x*.So, taking the square root of both sides of this inequality results in |*S*|> |*T*|.A nsw er choice (A) does not have to be true because *S* could be negative w hile *T* is positive.For exam ple,if *S* = -5 and *T* = 4,then $S^2 > T^2$.Testing fractions in answ er choice (B) show s that it does not have to be true.If S^2 = 1/9 and T^2 = 1/16,then *T* = 1/4 or -1/4.1/4 is greater than 1/9,w hich m eans that *T* can be greater than S^2.A nsw er choice (C) does not have to be true because *S* and *T* could have opposite signs.A nsw er choice (E) does not have to be true because *S* and *T* could have the sam e sign.

20.**(D).**This is a com binatorics problem in w hich *order m atters* (as it alw ays does w ith passcodes,ID codes,etc.) Since the identification num bers each have 7 digits,draw 7 slots.In each slot,list the num ber of possibilities for that slot.

Since the question asks only about identification num bers for people born in 1980,1981,and 1982,the identification num bers m ust begin w ith 80,81,or 82.Thus,only 8 (1 option) can go in the first slot.O nly 0,1,or 2 (3 options) can go in the second slot.

1	3					

N ote that there is no rule against repeating a num ber in an identification num ber (the problem gives the exam ple “a person born in 1963 could have the code 6344409”),so each rem aining slot can each contain any of the digits 0–9 (10 options).

1	3	10	10	10	10	10

This fundam ental counting principle states that the total num ber of choices is equal to the product of the independent choices.To calculate the answ er,m ultiply 1 × 3 × 10 × 10 × 10 × 10 × 10 = 300,000.

A lternatively,note that for each birth year,the part of the identification num ber unique to the individual is a 5-digit num ber.These could be 00000-99999 (99,999 + 1 = 100,000 options).There are 100,000 possible num bers for each of 3 years,or 300,000 identification num bers possible.